

WHAT IS CLAIMED IS:

1. A method of producing a semiconductor device for forming gate electrodes of a plurality of transistors supplied with different voltages on a semiconductor substrate via a gate insulating film, comprising the steps of:

forming said gate insulating film on said semiconductor substrate;

forming a gate electrode layer containing an impurity on said gate insulating film;

implanting an impurity at regions of said gate electrode layer for forming transistors where the electrical effective thickness required of said gate insulating film based on said voltage is relatively thin; and

processing said gate electrode layer to form gate electrodes with concentrations of impurities differing for each transistor.

2. A method of producing a semiconductor device as set forth in claim 1, wherein the step of forming said gate electrode layer comprises the steps of:

forming an amorphous silicon layer on said gate insulating film and

implanting an impurity in said amorphous silicon layer.

3. A method of producing a semiconductor device as

set forth in claim 1, wherein the step of forming said gate insulating film comprises forming on said semiconductor substrate said gate insulating film with different thicknesses between regions for forming transistors having relatively thin effective thicknesses of said gate insulating film and regions for forming transistors having relatively thick effective thicknesses of said gate insulating film.

4. A method of producing a semiconductor device for forming gate electrodes of transistors and upper electrodes of capacitors via insulating films on a semiconductor substrate, comprising the steps of:

forming lower electrodes of said capacitors in said semiconductor substrate;

forming an insulating film for forming gate insulating films of said transistors and capacitive insulating films of said capacitors on said semiconductor substrate and said lower electrodes;

forming an electrode layer containing an impurity for forming said gate electrodes and said upper electrodes on said insulating film;

implanting an impurity at regions of said electrode layer for forming transistors where the effective thickness required of said insulating film is relatively thin compared with said capacitors; and

processing said electrode layer to form said gate electrodes and said upper electrodes having different concentrations of impurities.

5 5. A method of producing a semiconductor device as set forth in claim 4, wherein the step of forming said lower electrodes comprises the steps of:

forming a sacrificial film on said semiconductor substrate;

10 implanting the impurity via said sacrificial film in regions of said semiconductor substrate for forming said capacitors so as to form said lower electrodes; and

removing said sacrificial film.

15 6. A method of producing a semiconductor device as set forth in claim 4, wherein the step of forming said electrode layer comprises the steps of:

forming an amorphous silicon layer on said insulating film and

implanting an impurity in said amorphous silicon layer.

20 7. A method of producing a semiconductor device as set forth in claim 4, wherein the step of forming said insulating film comprises forming said insulating film with different thicknesses between regions for forming the gate insulating films of said transistors and regions for forming
25 capacitive insulating films of said capacitors.

8. A semiconductor device comprising:
a semiconductor substrate and
a plurality of electronic circuit elements formed
at parts of the semiconductor substrate for each electrically
5 independent region and including insulating films and
electrodes formed on the insulating films,
the insulating films differing in required
electrical effective thickness for each electronic circuit
element, and
10 the electrodes having different concentrations
of impurities for each circuit element according to the
effective thickness.

9. A semiconductor device as set forth in claim 8,
wherein said electrodes of said electronic circuit elements
15 with thick required effective thicknesses have relatively
low concentrations of the impurities and said electrodes
of said electronic circuit elements with thin required
effective thicknesses have relatively high concentrations
of the impurities.

20 10. A semiconductor device as set forth in claim 8,
wherein said electronic circuit elements include a plurality
of transistors having said electrodes as gate electrodes
and said insulating films as gate insulating films.

11. A semiconductor device as set forth in claim 8,
25 wherein said electronic circuit elements include transistors

having said electrodes as gate electrodes and said insulating films as gate insulating films and capacitors having said electrodes as capacitive electrodes and said insulating films as said capacitive insulating films.

5 12. A semiconductor device as set forth in claim 8, wherein said insulating films are formed to substantially the same thicknesses.

 13. A semiconductor device as set forth in claim 8, wherein said insulating films are formed to different
10 thicknesses.